DRAFT FINAL

ALABAMA DROUGHT MANAGEMENT PLAN

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Executive Summary

In recent years, drought conditions have endangered Alabama's water resources and adversely affected the livelihood of many people. Drought is a natural event that, unlike floods or tornadoes, does not occur in a violent burst but gradually happens; furthermore, the duration and extent of drought conditions are unknown because rainfall is unpredictable in amount, duration and location. The devastation (environmental, social, and economic) experienced in recent years due to drought conditions has not been successfully mitigated because previous responses to drought conditions at all levels of government has been slow and fragmented, with little focus on preparedness and mitigation. In an effort to be more proactive, the Office of Water Resources worked closely with numerous local, state, and federal agencies and other water resources professionals to develop and implement this statewide approach to drought planning and management.

I. Purpose

The Alabama Drought Management Plan defines a process to address drought and drought related activities, such as monitoring climatic conditions, vulnerability assessments, impact assessments, response and mitigation. This plan creates a statewide regional structure to identify the different areas impacted by drought conditions, identify risks associated with drought conditions and identify ways to possibly avoid droughts and when drought emergencies cannot be avoided, identify ways to mitigate the impacts of droughts. These objectives are accomplished through the development of drought triggers and indicators and by providing guidance on responses to drought conditions for the various sectors impacted by droughts.

II. Drought Planning Overview

A. Role of the Office of Water Resources

As the agency responsible for the planning, coordination, development and management of Alabama's water resources in a manner that is in the best interest of the state, the Office of Water Resources shall coordinate efforts to compile and share information about drought impacts and responses by the following:

1. Oversee the monitoring and recording of data necessary for the determination of drought conditions;
2. Determine levels of drought after consultation with the Alabama Drought Assessment and Planning Team (ADAPT) and the Monitoring and Analysis Group (MAG);

3. Develop methods and procedures reasonably necessary to collect and distribute information, convene committees, promote water conservation and other means to encourage the wise stewardship of Alabama's water resources.

B. Alabama Drought Assessment and Planning Team (ADAPT)

The Alabama Drought Assessment and Planning Team serves in an advisory capacity to the Office of Water Resources and the Governor's Office, as needed to coordinate intergovernmental drought response and management and in the implementation of all drought related activities. In carrying out its responsibilities, the ADAPT shall:

1. Provide guidance and support to various aspects of drought management, including but not limited to:
    a) Establish drought management regions within the state to:
        i. enable drought mitigation to be accomplished within defined geographical areas, and
        ii. prevent overly broad response to drought;
    b) Establish drought alert phases based upon drought levels and at each phase:
        i. notify public water suppliers, municipal and county governments in the affected drought region, persons designated on notification lists, and other appropriate agencies and individuals;
        ii. publish notice of each drought alert phase on drought website and provide notice to the media in each drought region at each drought alert phase; and
    c) Review the Drought Management Plan at least every five years and after each drought event to evaluate the performance and suitability of the drought indicators, the effect of pre-drought and drought responses, and to what extent the plan is being followed. Based on this review, the ADAPT shall recommend appropriate changes.
2. Develop plans and procedures to support the implementation of a statewide Drought Management Plan and convene as necessary;
3. Provide guidance and make recommendations on drought related matters to the Office of Water Resources and the Governor, as necessary; and
4. Function within an organizational framework that includes:
    a) A statewide committee composed of the following members:
        - ADECA Office of Water Resources
        - Alabama Department of Environmental Management
        - Alabama Emergency Management Agency
        - Alabama Adjutant General
        - Alabama Department of Agricultural and Industries
        - Alabama Department of Conservation and Natural Resources
        - Alabama Forestry Commission
        - USDA Farm Service Agency
        - USDA Rural Development
        - Chairman of the Monitoring and Analysis Group (MAG)

- Chairman of the Drought Impact Group (DIG)

Other members may be added as needed.

b) The statewide committee shall be supported by two tiers: The MAG and the DIG to analyze and collect data that reflects past and current drought mitigation efforts and to assist with decisions concerning future drought mitigation efforts.

i. Monitoring and Analysis Group (MAG)
The technical support to ADAPT and the Office of Water Resources is provided by the Monitoring and Analysis Group (MAG). The MAG is comprised of federal, state, and local agencies and other water resources professionals. The duties of the MAG include:

1. Compiling surface water, groundwater, climatic, meteorological and other data necessary to assess drought conditions;
2. Recommending the level of conservation the state should implement and/or make suggestions to evaluate alternative water sources in an area during drought conditions;
3. Making observations and preparing reports on the long-term forecasts to enable the ADAPT to prepare for future droughts;
4. Deciding the most effective data for identifying droughts in the state and for computing data into a drought monitoring index; and
5. Evaluate the effectiveness of the indices, making modifications as needed.

ii. Drought Impact Group (DIG)
The drought impact and mitigation support to ADAPT and the Office of Water Resources is provided by the Drought Impact Group (DIG). The DIG is responsible for identifying drought impacts to water users and is representative of the following five drought impact sectors: agricultural affairs, domestic affairs, industrial affairs, recreational affairs, and environmental affairs. Each sub-group is comprised of state, local, private, and non-profit organizations and works together on issues that encompass more than one drought sector. The duties of the DIG include:

1. Identifying the vulnerabilities associated with a drought;
2. Taking actions to mitigate those vulnerabilities;
3. Developing long range strategies for mitigating the impacts of drought conditions; and
4. Assessing the actual impacts of the drought conditions within the state during drought conditions, and offering suggestions to alleviate the affects of the drought.

C. Drought Management Regions

To assess and respond to drought conditions in the most effective and efficient manner, nine drought management regions have been established as follows:

1. Drought Management Region 1 includes the following counties: Colbert, DeKalb, Franklin, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marshall and Morgan Counties.
2. Drought Management Region 2 includes the following counties: Bibb, Fayette, Greene, Hale, Lamar, Marion, Perry, Pickens, Sumter and Tuscaloosa Counties.
3. Drought Management Region 3 includes the following counties: Blount, Cherokee, Cullman, Etowah, Jefferson, Shelby, St. Clair, Walker and Winston Counties.
4. Drought Management Region 4 includes the following counties: Calhoun, Chambers, Chilton, Clay, Cleburne, Coosa, Randolph, Talladega and Tallapoosa Counties.
5. Drought Management Region 5 includes the following counties: Choctaw, Clarke, Dallas, Marengo, Monroe, Washington and Wilcox Counties.
6. Drought Management Region 6 includes the following counties: Autauga, Bullock, Elmore, Lee, Lowndes, Macon, Montgomery and Russell Counties.
7. Drought Management Region 7 includes the following counties: Butler, Conecuh, Covington, Crenshaw and Escambia Counties.
8. Drought Management Regions 8 includes the following counties: Barbour, Coffee, Dale, Geneva, Henry, Houston and Pike Counties.
9. Drought Management Regions 9 includes the following counties: Baldwin and Mobile Counties.

The establishment of drought management regions does not limit drought management efforts in an area smaller than a drought management region, such as a municipality, county, or watershed. Within an individual drought management area, drought assessment and response measures shall be considered and administered on individual levels.

III. Drought Information Center

The Office of Water Resources shall maintain a continuous clearinghouse of drought information and make this information available to the public as feasible such as utilization of a drought coordination website. A Drought Information Center will be maintained with the most current information whenever one or more drought management regions of the state are in a watch, warning or emergency drought alert phase. Information about the status of drought conditions, impacts on the economy and other drought related concerns of the state will be collected and made available to state agencies, state officials, the news media, and other concerned interests.

The MAG shall routinely collect, monitor, and evaluate selected climatic, water-supply and water-use data as necessary to identify at an early stage the onset of a drought or potential for drought, geographic extent of the affected area and changes in the drought levels.

The frequency of the drought indices computation shall be based on the drought phase. These computations will be compared with the various similar indices computed by other state, federal and private agencies.

Monitoring shall be accelerated whenever drought conditions approach or enter the drought watch stage in one or more drought management areas. This may include acquiring additional rainfall, streamflow, water use, and groundwater level data; and collecting additional information on the impact of the drought on agriculture, industry, domestic water supplies, and other users.

Available drought related data, as appropriate, will be provided to the MAG by the USGS, GSA, ADEM, NWS, NOAA, Office of State Climatologist, reservoir operators, as well as by industries, water authorities, and the general public that is either impacted by or has information on drought conditions. Various federal, state, and local agencies may be asked to provide drought information on a voluntary basis.

IV. Drought Impacts

Droughts are responsible for a wide range of potential impacts throughout the state. Several of these impacts have been categorized into possible social, environmental and economic implications that are directly or indirectly related to the drought. The risk of these potential impacts depends on the type of water demands, how these demands are met and the availability of water supplies necessary to meet these demands. These potential impacts should be integrated into the planning, mitigation, and response activities of local, state and federal agencies.

A. Statewide Concerns

In order to identify a detailed list of potential drought impacts, ADAPT created five broad categories of water use impacted by drought conditions and while each has category specific impacts, there are impacts that include multiple categories. The DIG coordinates with each of these categories of water use to determine the appropriate responses to each of the drought phases.

- Domestic Impacts - This category is impacted by water quantity and quality problems associated with public water supply. Prevention of water supply shortfalls and degradation of water quality is major concern of this impact group.
- Agricultural Impacts - This category of impacts is concerned primarily with soil moisture and precipitation forecast data. The timely and accurate assessment of agricultural conditions is vital for the appropriate mitigation and response mechanisms to be activated.

- Environmental Impacts – This category includes the efforts of various agencies and organizations striving to identify environmentally sensitive areas, develop strategies to prevent drought related disasters and develop emergency action plans.
- Industrial Impacts - The impacts associated with this group range from crop failures (processing, inspecting, and shelling industry), livestock losses (processing plants), navigational issues and revenues lost within all industries that use large amounts of water for production, such as pulp and paper, and power production.
- Recreational Impacts – These impacts affect homeowners, boat owners, and other users of reservoirs and water sources throughout the state that generate or depend on revenue through various recreational activities.

B. Regional Concerns

In the southeastern portion of the state, drawdown of the groundwater table through groundwater pumpage has created a public water shortage for water systems that are totally dependent on groundwater for their needs and in some instances this has impaired regional growth. Limited local water supply and financial constraints have worsened the existing water supply shortages, particularly during drought conditions and some water systems are seeking alternative water sources.

Some water systems in the southwestern portion of the state are also constrained by an inadequate water supply during drought conditions and this limits the potential for economic development and growth. Shortages in irrigation water supply for agriculture and fishery production has caused concern for neighboring private groundwater well users. Shallow private wells and springs are not dependable water sources for private water users and these users are evaluating the availability of additional water sources.

Central and west Alabama is confronted by low water levels during drought conditions that decrease sporting fishing, boating, lake visitations, and tourism. While public water supply is adequate in most areas, the social and economic impacts associated with the effects on the quality of life and the livelihood of persons employed by the marina, recreational and navigational industry are a major concern.

V. Drought Triggers

A. Introduction

Four phases of drought conditions are established, with each identified by a compilation of drought indices that are used to monitor and assess the severity of a drought, or to determine the drought stage. (The Lawn and Garden index is used as an indicator of the deficit over a three week period, expressed in inches of water needed to keep lawns growing; therefore, this indicator does not have much informational value during warning emergency phases.) Each of the nine drought regions has several indicators. If any one of the indicators in any one or more of the nine drought regions experiences a defined

condition for two consecutive months, a preliminary evaluation by the Office of Water Resources and the MAG is triggered.

Regional rainfall data provides and functions as a preliminary indicator for all phases of drought conditions. Rainfall deficit indices are used to assess the drought severity.

The need for the declaration of drought alert phases shall be verified by other means when necessary, including, but not limited to: other indices, water supply and demand, agricultural and forestry conditions, and historical climatological data.

Drought triggers do not automatically invoke a required response from the various categories of water users. The triggers do prompt additional monitoring and notices to the water systems and public regarding the ongoing drought conditions. The Office of Water Resources in coordination with ADAPT will notify the local governments and water utilities as to severity of the drought and make recommendations and provide guidance on the appropriate action to be taken during the four stages of droughts.

When any one of the triggers for a drought region is at a more severe level for a specific period, then the MAG and DIG evaluate the conditions relative to the region and make a recommendation to the ADAPT about whether to increase the drought alert phase and any suggestions for an increased level of response.

When most of the triggers for a drought region shows an improving trend for a specific period, MAG and DIG evaluate the conditions relative to the drought region and make a recommendation to the ADAPT about whether to decrease the drought alert phase and the level of response.

Drought triggers are specific values of indicators that help to determine when each level of suggested drought response should begin or end. Drought stage determinations are supported by, but not limited to, the following combinations of indices:

B. Drought Advisory

- Lawn and Garden Index, ranges from -1.5 to -2.0
- Crop Moisture Index, ranges from -0.5 to -0.9
- Palmer Drought Severity Index, ranges from -0.9 to -1.9
- Reservoir Elevation Level, ranges from 50 to 21 percentile

A drought advisory may be declared if any of the indices indicate a drought advisory phase; however, indication by one index alone does not mandate a declaration. The drought advisory phase shall initiate responses by the ADAPT and the Office of Water Resources. The Office of Water Resources shall routinely monitor the climatic variables, streamflow, reservoir levels and groundwater elevations in coordination with the MAG and shall notify the ADAPT and relevant state, federal, and local agencies that a region of the state is experiencing a drought advisory condition.

C. Drought Watch

- Lawn and Garden Index, Less than -2.0

- Crop Moisture Index, ranges from -1.0 to -1.9
- Palmer Drought Severity Index, ranges from -2.0 to -2.9
- Streamflow, ranges from 25 to 11 percentile
- Reservoir Elevation Level, ranges from 20 to 11 percentile
- Groundwater, ranges from 25 to 11 percentile

A drought watch may be declared if any of the indices indicate a drought watch; however, indication by one index alone does not mandate a declaration. During a drought watch, statements must be released to the news media by the Office of Water Resources, and the MAG and other appropriate agencies must accelerate monitoring activities.

D. Drought Warning

- Crop Moisture Index, ranges from -2.0 to -2.9
- Palmer Drought Severity Index, ranges from -3.0 to -3.9
- Streamflow, ranges from 10 to 6 percentile
- Reservoir Elevation Level, ranges from 10 percentile or less
- Groundwater, ranges from 10 to 6 percentile

A drought warning phase must be verified utilizing data and forecasts from various agencies and the MAG. Indication by one index alone does not mandate a declaration. Appropriate implementation of local water conservation and Drought Warning Ordinances will be encouraged.

E. Drought Emergency

- Crop Moisture Index, -3.0 or less
- Palmer Drought Severity Index, -4.0 or less
- Streamflow, ranges from 5 percentile or less
- Reservoir Elevation Level, at or below designated lower guide curve
- Groundwater, less than 5 percentile

The Office of Water Resources shall continue to evaluate information from various sources. Indication by one index alone does not mandate a declaration. Upon confirmation of a Drought Emergency, the Office of Water Resources (in coordination with ADAPT) will work with the Governor's Office to issue any statements or declarations related to the emergency. This may include, but is not be limited to, public statements that a drought emergency exists, disaster declarations, and the appropriate implementation of water conservation and drought emergency ordinances.

VI. Drought Response

A. Domestic Drought Response

Domestic and residential water suppliers are encouraged to develop local water conservation plans and/or ordinances to encourage reductions in water use during drought conditions or implement more severe restrictions if necessary. Sample water conservation ordinances are available upon request; however, the ordinances should be adjusted to address the drought vulnerabilities of the individual water systems and any pre-determined drought responses. These ordinances would provide for drought responses from the following uses, depending on the extent of the drought.

1. Outdoor Uses:
    - Established landscapes
    - Newly installed landscapes (in place less than 30 days)
    - Irrigating public maintained recreational parks and fields
    - Filling existing swimming pools
    - Washing vehicles
2. Indoor Uses

B. Agriculture Drought Response

Irrigation water users are encouraged to use best management practices and to use efficient irrigation systems during pre-drought conditions in addition to water conservation practices during droughts. Agriculture users are encouraged to coordinate responses to drought conditions and to help maintain an available supply for future use by:

1. Working through professional organizations and societies to develop and coordinate more efficient water management practices and drought procedures;
2. Promoting the development and distribution of information on water efficient irrigation techniques;
3. Providing information and encourage agricultural stakeholders to take advantage of available financial incentives for retrofitting and updating older or less efficient systems and distribute a list of such incentives;
4. Improving communications and cooperation among agricultural stakeholders and relevant state and federal agencies regarding available assistance during drought conditions;
5. Encouraging the installation of water efficient irrigation technology for newly installed systems;
6. Educating landscapers, nursery operators, and irrigators on proper application of pesticides and fertilizers and conservation of water to reduce effects on water quality.

7. Recommending irrigation system efficiency audits every five to seven years;

C. Environmental Drought Response

The appropriate local, state and federal agencies will help maintain adequate water quality, balancing demands with a need to protect the natural ecology, by:

1. Encouraging special releases from reservoirs and implementing innovative reservoir management to meet critical needs (e.g., alternative release patterns, controlling temperature of releases, changing storage purposes/authorized uses). (Implement only when not in violation or conflict with Federal Energy Regulatory Commission or Congressional authorizations.)
2. Reducing water withdrawals through water conservation ordinances and best management practices.
3. Encouraging utilities and local governments to increase surveillance for sewer spills and leaks that may have more severe impacts as drought conditions worsen.
4. Implement voluntary pollutant load reduction opportunities were possible (i.e., below levels in wastewater discharge permits) when flows are less than the flow upon which discharge permit limits were established.

D. Industrial Drought Response

Industries and other commercial water users are encouraged to coordinate water usage and constraints during drought conditions by:

1. Establishing more direct drought communication between the industrial sector and state and local governments and the appropriate water systems;
2. Conduct voluntary water audits for businesses that use water for a production or service, especially in an area that has a history of drought related water shortages;
3. Encourage the development and implementation of water conservation and drought contingency plans to limit any unnecessary consumption and interbasin transfers, if applicable, during droughts; and
4. Identify vulnerable water dependent industries and, as necessary and as funding is available, work to determine their impacts and provide assistance with procedures to curtail water use during droughts and/or identify alternative water sources for emergency use.
5. Implement industrial water reduction opportunities previously identified (i.e., use less water in producing products and services during drought, and thereby reducing quantity of wastewater in stream).

E. Recreation Drought Response

Homeowners, boat owners, and other users of reservoirs and water courses throughout the state that generate or depend on revenue through various recreational activities are encouraged to coordinate drought responses with the appropriate local, state, and federal agencies in an effort to:

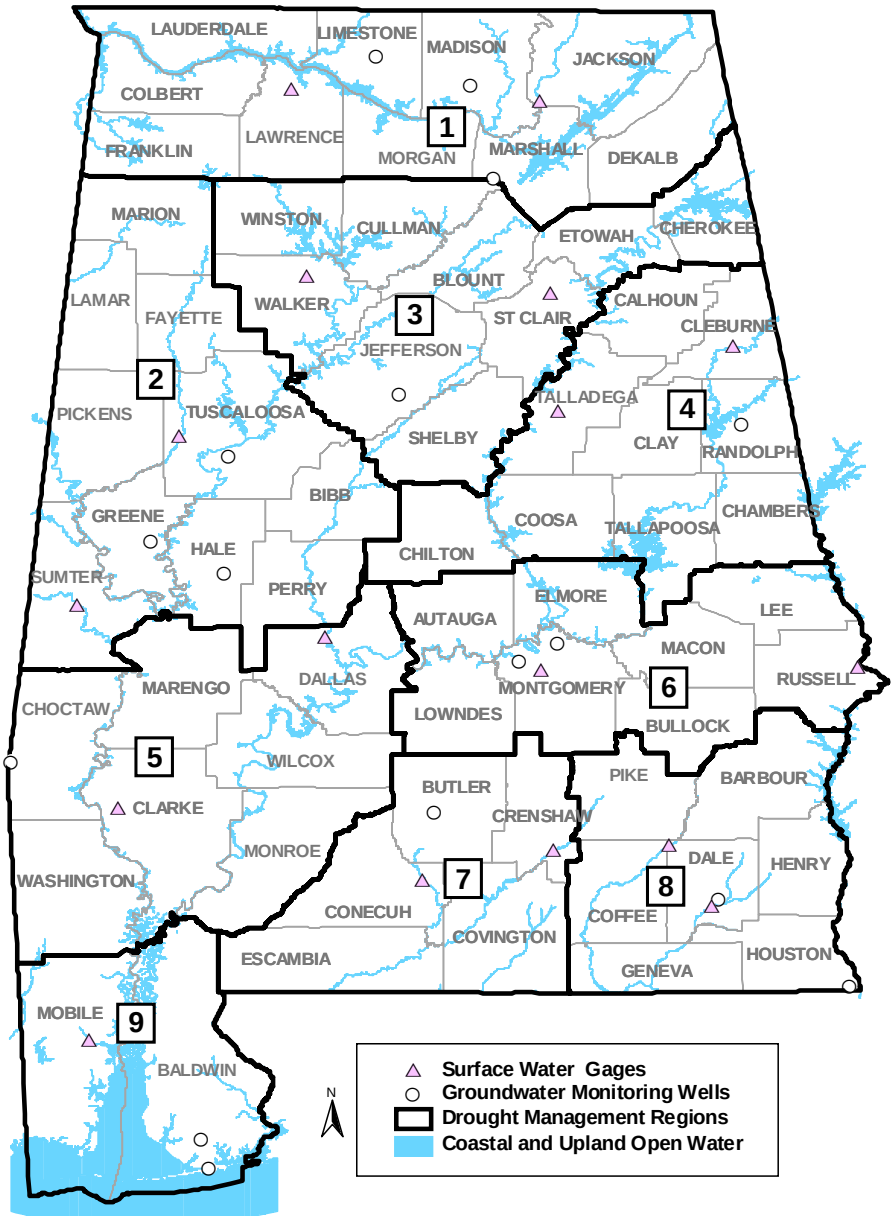
1. Investigate indicators and develop tools to analyze drought impacts for waterways used for recreation and sport fishing;
2. Develop and promote implementation of sustainable lawn care programs based on Best Management Practices; and
3. Educate individual homeowners on proper application of pesticides and fertilizers and conservation of water to reduce effects on water quality.

VII. Notification

Upon the inception of a new or increased drought alert phase, the ADAPT is responsible for disseminating public information concerning all aspects of the drought. The initial action in responding to drought must be public education, providing information as to existing and potential conditions and water conservation measures necessary to meet the demand presented at each drought watch phase. The OWR shall provide the following notices of drought phases:

1. Notify public water systems in the affected drought management region and other appropriate agencies and individuals beginning at the inception of a drought watch alert phase and as the drought alert is elevated to a higher phase.
2. Publish notice on the drought website and at least once in the media for general circulation in the areas affected beginning at the inception of a watch drought alert phase and as the drought alert is elevated to a higher phase.
3. Take any other actions appropriate to publicize drought alerts.

Attachment 1 Drought Management Regions and Monitoring Locations Map



Attachment 2 Monitoring Locations

Surface Water Gages

COUNTY	*ID*	*LOCATION*
Jackson County	USGS 03574500	PAINT ROCK NEAR WOODVILLE, AL
Lawrence County	USGS 03586500	BIG NANCE CREEK AT COURTLAND, AL
Tuscaloosa County	USGS 02446500	SIPSEY RIVER NR ELROD, AL
Sumter County	USGS 02467500	SUCARNOOCHEE RIVER AT LIVINGSTON, AL
Walker County	USGS 02453000	BLACKWATER CREEK NEAR MANCHESTER, AL
St. Clair County	USGS 02401390	BIG CANOE CREEK AT ASHVILLE, AL
Talladega County	USGS 02406500	TALLADEGA CREEK AT ALPINE, AL
Cleburne County	USGS 02412000	TALLAPOOSA RIVER NEAR HEFLIN, AL
Dallas County	USGS 02425000	CAHABA RIVER NEAR MARION JUNCTION, AL
Clarke County	USGS 02469800	SATILPA CREEK NEAR COFFEEVILLE, AL
Russell County	USGS 02342500	UCHEE CREEK NEAR FORT MITCHELL, AL
Montgomery County	USGS 02421000	CATOMA CREEK NEAR MONTGOMERY, AL
Conecuh County	USGS 02373000	SEPULGA RIVER NEAR MCKENZIE, AL
Crenshaw County	USGS 02371500	CONECUH RIVER AT BRANTLEY, AL
Dale County	USGS 02363000	PEA RIVER NEAR ARITON, AL
Dale County	USGS 02361000	CHOCTAWHATCHEE RIVER NEAR NEWTON, AL
Mobile County	USGS 02471001	CHICKASAW CREEK NEAR KUSHLA, AL

Groundwater Monitoring Wells

COUNTY	*ID*	*LOCATION*
Limestone County	LIM-4	FORT PAYNE CHERT
Madison County	MAD-2	FORT PAYNE CHERT
Marshall County	MAL-4	POTTSVILLE FORMATION
Greene County	GRE-3	EUTAW FORMATION
Choctaw County	CHO-1	NANAFALIA FORMATION
Jefferson County	JEF-1	BANGOR LIMESTONE
Tuscaloosa County	TUS-4	COKER FORMATION
Hale County	HAL-1	EUTAW FORMATION
Randolph County	RAN-1	PHYLITE OF THE WEDOWEE GROUP
Montgomery County	MTG-5	GORDO FORMATION
Montgomery County	MTG-4	GORDO FORMATION
Butler County	BUT-3	NANAFALIA FORMATION
Dale County	DLE-1	CLAYTON FORMATION
Houston County	HOU-1	CRYSTAL RIVER FORMATION
Baldwin County	BAL-5	SAND OF MIOCENE AGE
Baldwin County	BAL-2	SAND OF MIOCENE AGE

Attachment 3 Potential Drought Impacts

Categorized below is a detail list of possible social, environmental, and economical implications directly and indirectly linked to drought impacts.

Social Implications

Mental and physical stress (anxiety, depression, loss of security, domestic violence)
Health-related low-flow problems (cross-connections contamination, diminished sewage flows, increased pollutant concentrations, reduce fire fighting capability)
Reduction in nutrition (high-cost food limitation, stress-related dietary deficiencies)
Loss of human life (from heat stress, suicides)
Public safety from forest and range fires
Increased respiratory ailments
Increased disease caused by wildlife concentrations
Increased conflicts
- Water user conflicts
- Political conflicts
- Management conflicts
- Other conflicts (scientific, media-based)

Disruption of cultural belief systems (religious and scientific views of natural hazards)
Revaluation of social values (priorities, needs, and rights)
Reduction of modification of recreation activities
Public dissatisfaction with government regarding drought response
Inequity in the distribution of drought relief
Inequity in drought impacts based on socioeconomic group, ethnicity, age, gender, seniority
Loss of cultural sites
Loss of aesthetic values
Recognition of institutional restraints on water use
Reduced quality of life, changes in lifestyle, in rural areas, in specific urban areas, increased poverty in general
Increased data/information needs, coordination of dissemination actives
Population migrations

Environmental Implications

Damage to animal species
- Reduction and degradation of fish and wildlife habitat
- Lack of feed and drinking water
- Disease
- Increased vulnerability to predation (from species concentration near water)
- Migration and concentration (loss of wildlife in some areas and too many in others)
- Increased stress to endangered species

Damage to plant species

Increased number and severity of fires
Loss of wetlands
Estuarine impacts (changes in salinity levels)
Increased ground water depletion, land subsidence
Loss of biodiversity
Wind and water erosion of soils
Reservoir, lake and drawdown (including farm ponds)
Reduced flow from springs
Water quality effects (salt concentration, increased water temperature, pH, dissolved oxygen, turbidity)
Air quality effects (dust, pollutants)
Visual and landscaped quality (dust, vegetative cover)

Economic Implications

Loss from crop production
- Annual and perennial crop losses
- Damage to crop quality
- Reduced productivity of cropland
- Insect infestation
- Plant disease
- Wildlife damage to crops

Loss from livestock and dairy production
- Reduced productivity of rangeland
- Forced reduction of foundation stock
- Closure/limitation of public lands to grazing
- High cost/unavailability of water for livestock
- High cost/unavailability of feed for livestock
- High livestock mortality rates
- Disruption of reproduction cycles (breeding delays or unfilled pregnancies)
- Decreased stock weights
- Increased predation
- Range fires

Loss from timber production
- Wildland fires
- Tree disease
- Insect infestation
- Impaired productive of forest land

Loss from fishery production
- Damage to fish habitat
- Loss to young fish due to decreased flows
- Direct loss as a result of population reductions
- Direct loss to commercial fisherman wages
- Indirect loss as a result of fewer man-hours spent fishing
- Indirect loss to support facilities

Income loss for agricultural related industries

- Loss of farmers through bankruptcy
- Loss of sod, plants, trees, and shrubs, etc. to producers
- Loss of industries directly dependent on agricultural production (e.g. machinery and fertilizer manufacturers, food processors, etc)

Decline in food production/disrupted food supply
- Increase in food priced
- Increased importation of food (higher cost)

Unemployment from drought-related production declines

Loss to recreational and tourism industry
- Direct loss of hunting and fishing days
- Loss of state revenue from licenses
- Loss of revenue from retail sales of bait, tackle and hunting supplies
- Direct loss from visitors to hunting, golfing and fishing destinations
- Loss of recreational boating and associated revenue
- Turf destruction, loss of tree and shrubs
- Direct loss of revenue from course closures
- Indirect loss from ancillary support facilities

Loss manufactures and sellers of recreational equipment

Increased energy demand and reduced supply because of drought-related power curtailments

Costs to energy industry and consumers associated with substituting more expensive fuel (oil) or hydroelectric power

Disruption of water supplies

Revenue to water supply firms
- Revenue shortfalls
- Windfall profits

Strain on financial institutions (foreclosures, greater credit risks, capital shortfalls, etc)

Revenue losses to federal, state, and local governments (from reduced tax base)

Loss of impaired navigability of streams, rivers, and canals

Cost of water transport to transfer

Cost of new or supplemental water resource development

Cost of increased groundwater depletion, land subsidence, pumping cost

Reduction of economic development

Decreased land prices